SYSTEMS APPROACH FOR MANAGEMENT OF ARTIFICIAL INTELLIGENCE IN SELECT FINANCIAL SERVICES

A

Synopsis

Submitted in the partial fulfilment for the requirements of

Doctor of Philosophy

In

Management

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DAYALBAGH, AGRA – 282005

2020

SECTION 1: INTRODUCTION

Artificial Intelligence is the ability of a machine to perform cognitive functions which we generally associate with human minds, such as perceiving, reasoning, learning, and problem solving (McKinsey, 2018). It is also a branch of computer science that concerns the development of machines able to simulate human intelligence and actions. AI systems can also improve their performances while learning from their experiences. Artificial Intelligence consists of data driven technologies, like artificial neural network, machine learning, genetic algorithms, fuzzy logic, and robotics.

Just as much other technological advancement and result of Industry 4.0, Artificial Intelligence came to our lives and changed it in drastic way (Omar et al., 2017). It offers solutions superior to those of traditional methods of doing and human cognitive capacity. Consciously or unconsciously, Artificial Intelligence has become an integral part of our day to day lives. Even we do not know in how many ways, AI is involved in our daily routine. It is everywhere from Siri or Google Assistant in our phone to Netflix or Youtube recommendations or from smart LED lights to Alexa powered by Amazon.

Being an emerging technology, it has been applied in a variety of industries to serve functions which humans have often previously performed. Artificial Intelligence has a profound impact on just about every industry, and the financial services sector is no exception. The applications of artificial intelligence in financial services sector are many, from improving relationships with employees and customers to finding patterns in extreme data volume to perform repetitive tasks. There is strong agreement among IT decision makers of companies, providing financial services that AI is very much needed in this segment to dramatically improve operational efficiency and fundamentally transform this sector's core financial processes (NASSCOM, 2018). However, this can only happen if there is mass adoption of AI. The clear objective that stands out in this segment for using AI is to offer a more proactive and personal customer experience at a lower cost, followed by management of back-end business processes to reduce human error and to improve the turn-around-time for manual processes.

AI will have huge impact on various aspects of financial services operations, whether it is banking, financial services or insurance. As better and more advanced AI systems are being created, financial

services sector is becoming more curious to adopt such techniques in their operations, but there are many challenges that a firm has to face before in managing it and it comes with many complexities at individual, organisational, economical, national and international level which in turn, are not resulting in increased operational efficiency. Before an organization takes the initiative to adopt AI, the environment should be scanned and an adequate research should be conducted in the suitability of AI applications (Omar et al., 2017) and even after adoption proper management of this disruptive technology is crucial to align it with our goals. Considering the non-linearity and complexities of this sector, the proper management of this disruptive technology is crucial. Therefore, the present study focuses on addressing this issue.

The following research questions have been proposed in this concern:

i. What is the present status of AI technology in financial services and how it is managed at present?

ii. What factors are pushing the better management of AI and what factors are acting as barriers of management of AI in financial services?

iii. What will be optimal strategy for management of AI for value maximization of financial services sector?

Thus, the thesis will provide a relevant outlook on the enablers and challenges in management of artificial intelligence and its further impact on various dynamics considering value maximization of Indian finance sector. To the best of our knowledge, this is one of the early studies in this area in the Indian financial services sector.

SECTION 2: THEORETICAL BACKGROUND

2.1 Artificial Intelligence

The father of Artificial Intelligence, McCarthy (1956) defines AI as, “Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs”.

The Oxford English Dictionary defines artificial intelligence as "the theory and development of computer systems able to perform tasks normally requiring human intelligence". The Accenture report also says the same (Accenture, 2018). The technology – which enables machines to simulate and augment human intelligence – has finally come of age.

Artificial Intelligence (AI) is intelligence exhibited by machines. In computer science the field of AI defines itself as the study of "intelligent agents" (Mauersberger, 2017). Artificial intelligence (AI) refers to the use of digital technology to create systems that are capable of performing tasks commonly thought to require human intelligence (Banwo, 2018).

Generally, the term "AI" is used when a machine simulate functions that human's associate with other human minds such as learning and problem solving (Gupta, 2017). The technology –which enables machines to simulate and augment human intelligence – has finally come of age (Accenture, 2018).

Based on capabilities, there are three types of Artificial Intelligence, namely Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI).

Artificial Narrow Intelligence is the technology which imitates the human intelligence in a specific or some narrowly defined task. It is the ability of a machine to perform. ANI is also known as weak AI (Rouse, 2010).

Artificial General Intelligence is the stage of evolution of AI when machines will be able to do all the intellectual tasks like human beings. AGI is also known as strong AI (Rouse, 2010). Strong AI is considered as a threat to existence of human beings. According to Hawking, "The development of full artificial intelligence could spell the end of the human race. It would take off on its own, and re-design itself at an ever-increasing rate. Humans, who are limited by slow biological evolution, couldn't compete and would be superseded".

Artificial Super Intelligence is the stage of artificial intelligence when the capabilities of machines will surpass the human intelligence. It outperforms humans Intelligence by self-improvement that

lacks human's genetic limitations. It is currently a hypothetical situation. It is also known as 'Conscious AI' (Rouse, 2010).

2.2 Applications of Artificial Intelligence in Financial Services

a) **Fraud Prevention:** Fraud has long been a major issue for financial services institutions and as global transactions have increased, the danger has too. Fortunately, artificial intelligence has enormous potential to reduce financial fraud. To win the war against financial fraud, the segment providing financial services must abandon out-dated approaches. Identifying and preventing fraudulent transactions requires sophisticated solution, i.e. ML that can analyse high-volume data. By decoding patterns and using predictive analytics, machine learning algorithms can block fraudulent transactions. Fraud detection systems analyse clients' behavior, location, and buying habits and trigger a security mechanism when something seems out of order and contradicts the established spending pattern.

b) **Risk Management:** Artificial Intelligence is a game changer for risk management in finance as it provides banks and credit unions with tools and AI solutions to identify potential risks and fraud. 2017 and 2018 saw financial institutions adopting AI solutions for financial risk management. Traditional software applications predict creditworthiness based on static information from loan applications and financial reports. AI enriched with ML technology can go further and also identify unstructured data that can affect a client's ability to pay.

Of course, risk management also extends to preventing financial crime and financial crisis prediction. Machine learning in financial services provides solutions to these and many other risk concerns.

c) **Investment Predictions:** In recent years, hedge funds have increasingly moved away from traditional analysis methods. Instead, they have adopted machine learning algorithms for predicting fund trends. Using machine learning, fund managers can identify market changes earlier than is possible with traditional investment models.

d) **Customer Service**: Customer service is the bread for every business. The simple truth is that without satisfied customers, you'll soon be out of business. Artificial Intelligence is currently being deployed

in customer service in the form of chatbots and virtual agents with the primary goals of improving the customer experience and reducing human customer service costs. While the technology is not yet able to perform all the tasks a human customer service representative could, many consumer requests are very simple ask that sometimes be handled by current AI technologies without human input.

Whether customers are speaking with a human, or using a virtual assistant, customers want accurate information and fast solutions to their problems.AI technology has empowered customer support allowing customers to interact with their banks from anywhere and anytime. Machine learning puts a new spin on virtual assistants by enabling them to learn, rather than simply following a prescribed set of instructions.ML-based chatbots adapts their approach based on the behavior of each customer. The result is a chatbot that acts and feels more human for an improved customer experience (North, 2019).

e) **Cyber Security:** Data security is at the top of the list whenever financial institutions are asked about their concerns and it must be as data of financial services segment is the data of savings and investments of millions and billions of people.

The challenge to identify modern sophisticated cyber-attacks cannot be relegated to yesterday's security software. To meet the security threats financial institutions now face requires advanced technology.AI enabled security solutions are uniquely capable of securing the world's financial data. The power of intelligent pattern analysis, combined with big data capabilities, gives ML security technology an edge over traditional, non-AI tools.

f) **Underwriting:** The insurance sector is also coming up with a storm as they are moving towards congruent automation (Vijai, 2019). A growing number of insurance companies have turned to AI to help identify risks and to help set premiums. Since machine learning makes predictions based on historical patterns and current trends, it is the perfect vehicle for insurance companies to improve profitability. AI enabled fitness and vehicle tracking system in both health and auto insurance sector give rise to the dynamic, intelligent underwriting algorithms that cleverly control the way premium is dictated. Using Artificial Intelligence and Machine Learning, insurers can save a lot of time and

resources involved in the underwriting process and tedious questions and surveys, and automate the process. The same advantages apply to the banking sector. Financial institutions that offer insurance products to their clients yield the same benefits from ML as insurance companies.

g) **Algorithmic Trading:** Algorithmic trading automates the trading process by executing trades according to predefined criteria set by the trader or fund manager. In its simplest form, an "algo" trade can automatically buy (or sell) a quantity of stock when the price-per reaches a specific level.

AI technology offers a new and diverse suite of tools to make algorithmic trading intelligent.ML algorithms are designed to analyse historical market behavior, determine an optimal market strategy, to make trade predictions, and more.

h) **Money-Laundering Prevention**: An estimated 2%-5% of the global GDP is laundered annually. Unfortunately, FIs have not been winning the battle. AI technology can be utilised by FIs in anti-money laundering (AML) by analysing the large amounts of data, to flag false alerts and identify complex criminal conduct. It can identify connections and patterns that are too complex to be picked up by straightforward, rule-based monitoring or the human eye.

i) **Personalised Financial Services:** Customers are ever-more demanding, and want fast, high quality and above all personalized service from the organizations that they deal with. Tools of AI in financial services segment will become the primary method of interaction between customers and banks. It will automate a large number of banking processes and result in a better understanding of customer behavior and expectations. Consequently, banks will be able to provide more personalized and customer-centric services (Gauvrit, 2017; Jackson, 2017).

j) **Wealth Management:** With growing per capita income, people are looking for advanced and secured ways to manage their financial health. Therefore, many financial institutions and banks are using AI to guide their clients with investments. Advanced methods of AI are efficient in creating effective solutions and provide lucrative returns for both clients and companies (North, 2019).

2.3 Benefits of AI for Finance Sector

AI has the potential to transform just about every existing industry, yet, in the banking, financial services and insurance sector it can truly unleash its transformative potential. Below, is a list of some tangible benefits that AI applications can bring to the table in finance sector.

a) **More Accuracy and Predictability:** The primary goal of AI is to increase accuracy and predictability of outcomes and reduce human errors in business processes, particularly manpower intensive ones. Data driven accurate decisions at lower cost lead to a different style of management which can help leaders and subordinates to take better decisions.

b) **Availability:** AI based solutions can work 24/7 without taking breaks or getting tired.

c) **Scalability:** AI tools and techniques are scalable because they use deep learning technology to continuously improve themselves through self-learning.

d) **Digital Fraud Detection and Prevention:** Anomaly detection can be used to increase the accuracy of credit card fraud detection and anti-money laundering (Vijai, 2019). UPI transactions and digital payments are growing month-on-month, it will lead to an equally big spike in digital frauds. AI technologies can monitor huge volumes of digital transactions to identify and prevent digital frauds. Suspicious behaviour, logs analysis, and spurious emails can be tracked down to prevent and possibly predict security breaches.

e) **Understand Customer Behaviour:** As customers go online, AI will be required to analyse customer behaviour by tracking the websites which consumer frequently visits and the frequently used method of payment and improve their experience.

f) **Maintain Regulatory Compliance:** Negligence in security measures could lead to financial losses.AI can help companies to analyse data to detect any regulatory deviations to stay on the right side of the law.

g) **Digitization and automation in back-office processing:** Capturing documents data using OCR and then using machine learning/AI to generate insights from the text data can greatly cut down back-office processing times.

h) **Customer Retention:** Tailored products can be offered to clients by looking at historical data to retain the customer for longer period.

2.4 Present Status of AI in Indian Finance Sector:

Research institutions and universities have been working with various AI technologies for decades, and especially in the area of social transformation. With enabling technologies becoming a lot more accessible and inexpensive, AI is now becoming main stream, with large enterprises and start-ups. A research showed that the adoption of AI has the potential to add nearly $1 trillion to the Indian economy in 2035 (Accenture, 2017). India is now global hub for financial services, which account for more than half of India's IT services and Business Process Management (BPM) exports (NASSCOM, 2018).

Indian banks like SBI, HDFC, ICICI, HSBC and Axis banks in India have turned towards AI in a significant way. Below we provide brief details of some of these initiatives:

Table 1 : Present Applications of AI in Finance Sector

Organizations	AI applications
State Bank of India (SBI)	**1.** Conducted "Code for Bank" hackathon. **2.** Launched beta testing SIA- SBI Intelligent Assistant.
Canara Bank	**1.** Installed a robot named Mitra at its Chennai Branch. **2.** Launched its first digital banking branch 'CANDI'.
HDFC Bank	**1.** Chatbot- 'Electronic Virtual Assistant', or EVA. **2.** Humanoid- Intelligent Robotic Assistant or IRA.
HDFC Life Insurance	AI based email bot, named SPOK.
ICICI Bank	**1.** Chatbot- iPal. **2.** Deployed robotic software.
Axis Bank	**1.** Virtual Assistant- Axis AHA. **2.** Cheque authentication by AI.
ICICI Lombard	**1.** Chatbot- MyRA. **2.** Robotic Process Automation to automate mundane tasks.
Fullerton India Credit Company Ltd.	Chatbot- ASHA
Policy Bazaar	Chatbot- PBee
Kotak Mahindra Bank	Chatbot- Keya
Punjab National Bank (PNB)	Using AI in account reconciliation.
PNB Metlife	Chatbot- Dr. Jeevan
National Stock Exchange	Working on artificial intelligence to strengthen its surveillance operations to prevent any manipulative activities.

Bombay Stock Exchange	Uses data analytics based system solution.

SECTION 3: REVIEW OF LITERATURE AND IDENTIFICATION OF RESEARCH GAP

3.1 Review of Literature

The review of literature for the proposed research is performed to understand the basic concepts and insights of AI and financial services sector of India as well as abroad.

Classification of Literature Review: A broad classification of the previous papers is given as follows:

1. **Focus of the paper**
   - Banking
   - Financial Services
   - Insurance
   - Artificial Intelligence
2. **Context of the paper**
   - Indian
   - Foreign
3. **Type of Data for analysis**
   - Qualitative
   - Quantitative
4. **Research Design**
   - Exploratory
   - Descriptive
   - Analytical

Table 2: Synthesis Matrix of Literature Review

Summary of Literature Review												
		Focus Issue				Context		Data Type		Methodology		
Title ***Author(s) (Year)***	**Category**	**Banking**	**Financial Services (Stock Market/Portfolio Management/ NBFC)**	**Insurance**	**Artificial Intelligence**	**Indian**	**Foreign**	**Qualitative**	**Quantitative**	**Exploratory**	**Descriptive**	**Analytical**
Artificial Intelligence, Expert Systems, and Financial Planning *Jay T. Brandi (1988)*	Research Paper		✔		✔		✔	✔			✔	
Artificial Intelligence and Financial Services *L.F. Pau (1991)*	Research Article		✔		✔		✔		✔			✔
Artificial Intelligence and Expert Systems in Accounting Databases: Survey and Extensions *Daniel E. O'Leary (1991)*	Review Paper				✔		✔	✔				✔
Artificial Neural Network and the Financial Markets: A Survey *Amitava Chatterjee, O. Felix Ayadi and Bryan E. Boone (2000)*	Research Artcle		✔				✔		✔			✔
Artificial Intelligence in Portfolio Management *Man-Chung Chan, Chi-Cheong Wong, W.F. Tse, Bernard K.-S. Cheung and Gordon Y.-N. Tang (2002)*	Research Article		✔		✔		✔		✔			✔
Application of neural networks to stock prediction in "pool" companies *Oscar Sapena , Vincente Botti and Estefania Argente (2003)*	Research Article		✔				✔		✔			✔

Summary of Literature Review (Contd.)												
Title ***Author(s) (Year)***	**Category**	**Focus Issue**				**Context**		**Data Type**		**Methodology**		
		Banking	**Financial Services (Stock Market/Portfolio Management/NBFC)**	**Insurance**	**Artificial Intelligence**	**Indian**	**Foreign**	**Qualitative**	**Quantitative**	**Exploratory**	**Descriptive**	**Analytical**
Opportunities for Artificial Intelligence Development in the Accounting Domain: The Case for Auditing *Amelia A. Baldwin, Carol E. Brown And Brad S. Trinkle (2006)*	Review Paper				✔		✔		✔			✔
Assessing Bank Efficiency and Performance with Operational Research and Artificial Intelligence Techniques: A Survey *Meryem Duygun Fethi, Fotios Pasiouras (2009)*	Research Article	✔			✔		✔	✔				✔
Stock Price Prediction using Neural Network with Hybridized Market Indicators *Adebiyi Ayodele, K. Ayo Charles, O. Adebiyi Marion , and O. Otokiti Sunday (2012)*	Research Article		✔				✔		✔			✔
The Role of Artificial Intelligence in the Development of Accounting Systems: A Review *Syed Moudud – Ul - Huq (2014)*	Review Paper				✔		✔	✔				✔
Reducing Risk in KYC (Know Your Customer) for large Indian banks using Big Data Analytics *Anuraj Soni, Reena Duggal (2014)*	Research Article	✔				✔		✔			✔	
Enablers and restrictors of mobile banking app use: A fuzzy set qualitative comparative analysis (fsQCA) *Jose Manuel Cristovao Verissimo (2016)*	Research Article	✔	✔				✔		✔			✔

Summary of Literature Review (Contd.)												
Title ***Author(s) (Year)***	**Category**	**Focus Issue**				**Context**		**Data Type**		**Methodology**		
		Banking	**Financial Services (Stock Market/Portfolio Management/NBFC)**	**Insurance**	**Artificial Intelligence**	**Indian**	**Foreign**	**Qualitative**	**Quantitative**	**Exploratory**	**Descriptive**	**Analytical**
Stock Market Index Prediction using Artificial Neural Network *Amin Hedayati Moghaddam, Moein Hedayati Moghaddam and Morteza Esfandyari (2016)*	Research Article		✔				✔		✔			✔
The Effects of Artificial Intelligence and Robotics on Business and Employment: Evidence from a survey on Japanese firms *Morikawa Masayuki (2016)*	Discussion Paper				✔		✔		✔			✔
Adoption of Robots, Artificial Intelligence and Service Automation by Travel, Tourism and Hospitality Companies – A Cost-Benefit Analysis *Stanislav Ivanov, Craig Webster (2017)*	Conference Proceedings				✔		✔	✔		✔		
Investigating An Innovative Service with Hospitality Robots *Chun-Min Kuo, Li-Cheng Chen, Chin-Yao Tseng (2017)*	Research Article				✔		✔	✔				✔
A Literature survey on Artificial Intelligence *Nishika Gupta (2017)*	Conference Proceedings				✔		✔	✔			✔	
The Diffusion of Artificial Intelligence in Governance of Public Listed Companies in Malaysia *Siti Aisyah Omar, Farhana Hasbolah and Ulfah Mansurah Zainudin (2017)*	Research Article				✔		✔	✔				✔

Summary of Literature Review (Contd.)													
Title ***Author(s) (Year)***	**Category**	**Focus Issue**				**Context**		**Data Type**		**Methodology**			
		Banking	**Financial Services (Stock Market/Portfolio Management/NBFC)**	**Insurance**	**Artificial Intelligence**	**Indian**	**Foreign**	**Qualitative**	**Quantitative**	**Exploratory**	**Descriptive**	**Analytical**
Artificial Intelligence in Finance: Forecasting Stock Market Returns using Artificial Neural Networks *Alexandra Zavadskaya (2017)*	Thesis		✔		✔		✔		✔			✔
Artificial intelligence and machine learning in financial services: Market developments and financial stability implications *Financial Stability Board (2017)*	Report		✔		✔		✔	✔				
Economic Policy for Artificial Intelligence *Ajay Agrawal, Joshua Gans, Avi Goldfarb (2018)*	Working Paper				✔			✔				✔
Artificial Intelligence in Corporate Banking: A Closer Look at the Potential Impact on E-Business Processes *Jonas Uyttendaele, Supervisor- Prof. Dr. Steve Muylle (2018)*	Dissertation	✔			✔		✔	✔				✔
Artificial Intelligence in Finance The Road Ahead *Paul Dravis (2018)*	Report		✔		✔		✔	✔			✔	
AI in Banking and Finance *Saman Goudarzi, Elonnai Hickok, Amber Sinha (2018)*	Report	✔			✔	✔		✔				
ANN Model to Predict Stock Prices at Stock Exchange Markets *Barack Wamkaya Wanjawa, Lawrence Muchemi*	Research Paper		✔				✔		✔			✔

Summary of Literature Review (Contd.)												
Title ***Author(s) (Year)***	**Category**	**Focus Issue**				**Context**		**Data Type**		**Methodology**		
		Banking	**Financial Services (Stock Market/Portfolio Management/NBFC)**	**Insurance**	**Artificial Intelligence**	**Indian**	**Foreign**	**Qualitative**	**Quantitative**	**Exploratory**	**Descriptive**	**Analytical**
The Impact of Artificial Intelligence (AI) on Financial Job Market *David He, Michael Guo, Jerry Zhou and Venessa Guo (2018)*	Report				✔		✔					
National Strategy for Artificial Intelligence #AIFORALL *Anna Roy, Amitabh Kant (2018)*	Discussion Paper				✔	✔		✔			✔	
Analysis of the Impact of Artificial Intelligence Application on the Development of Accounting Industry *Jiaxin Luo, Qingjun Meng, Yan Cai (2018)*	Research Article				✔		✔	✔				✔
Artificial intelligence and financial services: Regulatory tracking and change management *Adedayo Banwo (2018)*	Review Paper		✔		✔		✔	✔				✔
Artificial Intelligence for Banking, Financial Services and Insurance Sector *NASSCOM and CMR (2018)*	Report	✔	✔	✔	✔	✔						
The economics of artificial intelligence: Implications for the future of work *Ekkehard Ernst, Rossana Merola, Daniel Samaan (2018)*	Research Paper				✔		✔	✔				✔
Variable Selection for Artificial Neural Networks with Applications for Stock Price Prediction *Gang-Hoo Kim and Sung-Ho Kim (2018)*	Research Article		✔				✔		✔			✔

Summary of Literature Review (Contd.)												
Title ***Author(s) (Year)***	**Category**	**Focus Issue**				**Context**		**Data Type**		**Methodology**		
		Banking	**Financial Services (Stock Market/Portfolio Management/NBFC)**	**Insurance**	**Artificial Intelligence**	**Indian**	**Foreign**	**Qualitative**	**Quantitative**	**Exploratory**	**Descriptive**	**Analytical**
Using AI to Make Predictions on Stock Market *Alice Zheng and Jack Jin (2018)*	Research Paper		✔		✔		✔		✔			✔
Using artificial intelligence to create value in insurance *Mikko Riikkinen, Hannu Saarijärvi, Peter Sarlin, Ilkka Lähteenmäki (2018)*	Research Article			✔	✔		✔	✔				✔
Artificial Neural Network: Validity of Technical Analysis Indicators for predicting Stock Prices *Navita Nathani, Jaspreet Kaur, Divya Khator (2019)*	Research Article		✔			✔			✔			✔
Indian shopper motivation to use artificial intelligence: Generating Vroom's expectancy theory of motivation using grounded theory approach *Komal Chopra (2019)*	Research Article				✔	✔		✔				✔
Artificial Intelligence in Indian Banking Sector: Challenges and Opportunities *Dr. C. Vijai (2019)*	Research Article	✔			✔	✔		✔			✔	
Evolution and control of artificial super intelligence (ASI): a management perspective *Karan Narain, Agam Swami, Anoop Srivastava, Sanjeev Swami (2019)*	Research Article				✔	✔		✔				✔

3.2 Research Gap

Although previous researchers have provided significant contributions in the field of AI (Agarwal et al., 2018; Ivanov, Webster, and Berezina, 2017; Kannabiran and Dharmalingam, 2012; Yu, Beam , and Kohane , 2018; Narain et al., 2019; Kuo et al., 2017; Masayuki, 2016; Omar et al., 2017), such research works have not primarily focused on the financial services sector, particularly in the Indian context. A very few studies have been conducted in relation to AI in whole financial services sector. Individually, there are some studies in banking sector (Uyttendaele and Muylle, 2018; Ince and Aktan, 2009; Goudarzi et al., 2018; Celik and Karatepe, 2007) and in financial services (Chan et al., 2002; Chatterjee et al., 2000; Moghaddam et al., 2016; Moudud-Ul-Huq, 2014), but not specifically in the Indian context. Yet, two studies have reviewed AI in banking and Finance respectively (Goudarzi et al., 2018; Vijai, 2019).

There is only one practice-oriented study regarding AI in whole financial services segment, i.e. a report by NASSCOM on AI for Banking, Financial Services and Insurance Sector (NASSCOM, 2018). Only one study has been found which has examined the management perspective of AI (Narain et al., 2019) which is not considering the financial services.

From methodological point of view, none of the study has attempted for applying systems approach in the management of this disruptive technology in financial services sector.

This study is an attempt to fill the gap of use of systems approach to understand the management of AI in financial services sector and provide bird eye view. Therefore, this study will provide a strategic framework is required in the light of existing enablers and challenges of management of AI so that the value of financial services sector can be maximized.

SECTION 4: CONCEPTUAL FRAMEWORK

The researcher has proposed conceptual framework which investigates the enabling factors to the management of artificial intelligence in financial services. Furthermore, it includes he identification of challenges to financial services sector for AI management. The model also tries to understand the

relationship with value maximization in financial services sector, with the efficient management of Artificial Intelligence.

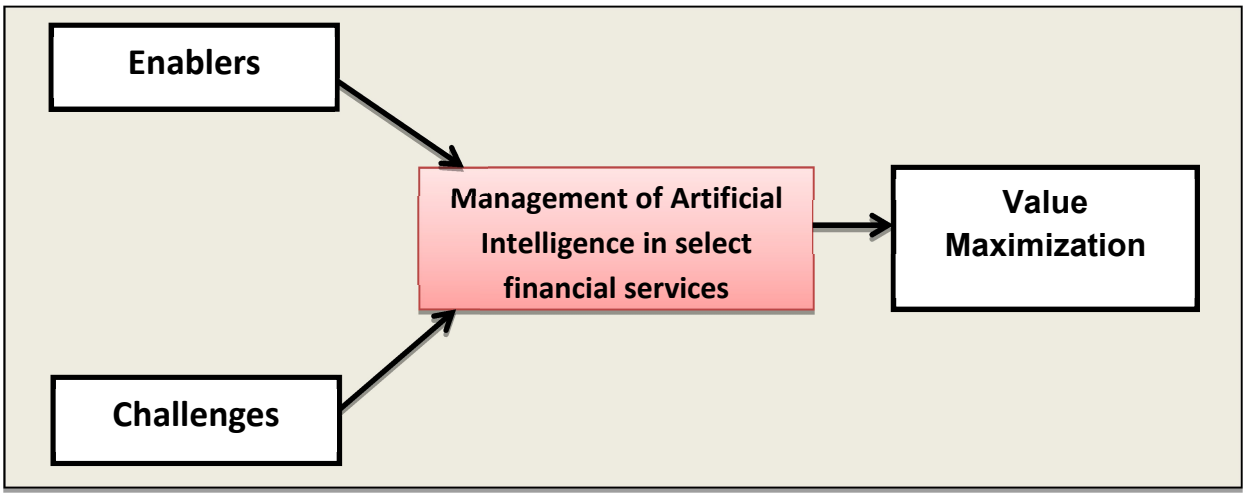

Figure 1: Conceptual Framework (Source: Researcher's own construct)

4.1 Enablers of AI Management:

For any kind of management, there are some enabling or driving factors that are pushing the efficient management. For example, Robust and rapid processing needs, advent of mobile technology, data availability, and proliferation of open-source software offer management of AI a huge scope in the financial services sector. Companies those who instead view incorporating AI as building a new long-term capability have the best chance to transform their organizations for competitive advantage (Sinclair et al., 2018). In fact, according to an Industrial Development Corporation study, over half of best-run midsize businesses view AI, machine learning, and digital assistants as critical enablers and necessities for staying competitive, compared to approximately 13% of digital laggards.

Several studies have demonstrated that technology adoption has a positive relationship with perceived usefulness (Schierz et al., 2010; Talukder, 2012). In the case of AI, usefulness can be defined in the following considerations: robots, chatbots and self-service kiosks can operate 24/7, much more than human employees. Furthermore, chatbots can serve numerous customers simultaneously, which is not the norm with human employees. Machines can perform the same task thousands of times without

complaints. AI could enhance perceived service quality, create value for customers, save employees' time (Ivanov et al., 2017).

The demand for efficient management of AI is also due to regulatory compliance. New regulations have pushed banks to automate and adopt new analytical tools that can include use of AI and machine learning (Adobe, 2019; Financial Stability Board, 2017). One of the primary objectives using AI is to monitor all processes and data for regulatory compliance and security (Rupali, 2018). In an era of cyber-crime and stringent regulatory requirements, a highly fraud-resistant system for protecting and authenticating almost any kind of transaction could have a revolutionary impact on the financial services industry (PwC, 2016).

Several studies (Goudarzi et al., 2018; NASSCOM, 2018; Roy and Kant, 2018; Rupali, 2018) found that factors such as technical support, personal innovativeness, incentives, image and enjoyment with innovation have stronger influence on management of innovation. Availability of computing power owing to faster processor speeds, lower hardware costs, and better access to computing power via cloud services, cheaper storage, parsing, and analysis of data through the availability of targeted databases, software, and algorithms, trust and corporation of employees on management's decision to implement AI tools and techniques are also a enabling factors for management of AI in an organization. The present research will try to determine such more enablers for management of Artificial Intelligence in financial services sector.

4.2 Challenges in Management of Artificial Intelligence:

Any change cannot be implemented without facing any challenge, so is the case with management of AI adoption. There are a number of key challenges faced by companies those want to move towards automation and AI. A magnificent well – informed AI system will be exceptionally satisfying at performing its goals but we do have to align those goals with ours (Gupta, 2017). As per the discussion paper, National Strategy for Artificial Intelligence #AIFORALL (2018), the challenges that any company can face regarding AI in India are concentrated across common themes of:

1) Lack of enabling data ecosystems
2) Low intensity of AI research
    a) Core research in fundamental technologies
    b) Transforming core research into market applications
3) Inadequate availability of AI expertise, manpower and skilling opportunities
4) High resource cost and low awareness for adopting AI in business processes
5) Unclear privacy, security and ethical regulations
6) Unattractive Intellectual Property regime to incentivise research and management of AI.

For AI enablers in finance such as Kasisto, Voyager Labs, IBM Watson Cyber security, and Amazon's Alexa platform, the underserved market presents vast opportunities for engagement, but only if they can creatively overcome the industry's daunting challenges. Other firms cited "siloed data sets, regulatory compliance, fear of failure and unclear internal ownership of emerging technologies" act as main thwarting factors for innovation (Zhou, 2017). A similar study by PWC (2017) showed that two in every three financial services firms in the US were hindered in AI adoption by "operations, regulations, and limitations in budget or resources". Some challenges have been briefly described below:

a) **Resistance to change**- Change is always inevitable so is resistance to change. Resistance to change is one of the biggest obstacles to any change program. It is basic human nature of people to try and keep their customs, methods and way of doing routine tasks constant. Adopting the new technology would require reengineering of the processes within the company, rewriting the service operations manuals and training staff to use the new technology, thus putting employees outside their comfort zones. They may be afraid of the change and consider the technology as a threat for their jobs (Ivanov et al., 2017). The resistance of change is a barrier in effective management of artificial intelligence in this sector because this sector is already based on so many risks and returns.

b) **AI management is Expensive**- The use of robots, self-service kiosks, chatbots or any other AI-enabled software or machine is not free and require financial resources in several directions, i.e.

Acquisition cost, installation cost, maintenance cost, software update cost, cost for hiring specialists, cost for staff training, etc. (Ivanov et al., 2017). Currently, AI is still in its infancy stages. That, coupled with its high price tag, makes it a tool that is out of reach for the average individual investors (Chatterjee et al., 2000).

c) **Customers' readiness and willingness to be served by machines**- Customers may resist being served by a robot or serve themselves via a kiosk, and prefer a human employee. In such situation automating the service delivery process might not yield the expected positive results for the company (Ivanov et al., 2017).

d) **Lack of Credible and Quality Data**- Artificial intelligence thrives with data. The more data you have, the better your algorithms will be. However, just having a lot of data is not sufficient anymore. Artificial intelligence supports decision by analysing enormous information (Chan et al., 2002). You also need high-quality data (Rijmenam, 2019), or in the words of Peter Norvig, you need better data:

"We don't have better algorithms, we just have more data. More data beats clever algorithm, but better data beats more data." - Peter Norvig - Director of Research, Google.

e) **Lack of required skills and knowledge-** AI is generating the demand for new skill sets in workplace. There is a wait for right talent pool to deploy it properly. The lack of well-trained professionals who can build and direct a company's AI and digital transformation journeys noticeably hinders progress and continues to be a major hurdle for businesses (NASSCOM, 2018).

f) **Others-** There are a lot of other challenges also that financial services sector is facing in management of AI. Some of them are: Identifying the right AI vendor, Immaturity of industry standards around AI based systems, Training the deep learning systems to work efficiently with less data, Structuring the data according to AI based system, Getting the AI system to interpret questions correctly, High cost of investment, Convincing top management to deploy AI, Addressing security and privacy issues, etc. This research will try to determine such more challenges faced by financial services sector in management of AI.

4.3 Value Deliverables: Every business entity be it of financial services sector or any other, needs the maximization of the value deliverables to remain in the competition. The concept of value in organisations is measured in terms of risks and returns. The following measures would be used for measuring value of financial services sector to examine the value delivered through efficient management of AI:

Table 3: Value Deliverables

Risks	Volatility of shares/ market
Returns	**Profitability Indicators** • Return on Investment • Return on Assets • Earnings Per Share **Soundness Indicators** • Non-Performing Loans to Total Loans Ratio • Loans to Deposits Ratio • Capital to Risk Adjusted Ratio

It is indicated in the past researches that the technology intervention improves the productivity of organizations. The productivity-improved results will be checked with the help of given indicators (Table 3). These indicators are not only affected by AI. The researcher intends to check the influence of management of AI on these factors.

SECTION 5: COMPLEXITY OF THE PROBLEM

Dealing with complexity requires shifting our focus so as to look at not just the parts to a system but also the overall macro system as a whole. A complex system is one that has many diverse components that are highly interconnected and interdependent and the same can be said of finance sector. The finance sector is too complex and so many transactions take place in it like. Finance systems allow funds to be stored and moved between economic actors; they enable individuals and organizations to share and exchange ownership with the associated risks and returns. Being in a same system, each and every factor acts as a sub-system and somehow these sub systems affects every other sub-system and other sub-systems affect them as well. Each element of a system is composed of smaller subsystems,

which may contain sub-subsystems. Each element of an open system also connects to a larger environment. This shows a non-linear complex scenario. If visualized, all these factors are connected to each other in a complex web like structure as dependent variables and drivers (variables that drive other variables). The same is applied in finance sector. All complex systems involved emergence and the formation of qualitatively different levels, from the micro to the macro. FINANCIAL SERVICES systems also operate at all levels **from personal finance, to corporate finance, to national, to the global financial system** indicating micro to macro.

The proper management of AI is very critical in this complex system. The management of technology has certain entry-level enabling factors with possible implementation and maintenance related challenges acting as obstacles to achieve the value like increase in financial performance, accuracy in decision making, customer retention and engagement, etc.

The proposed problem is complex because we cannot take AI as any other change. It is single biggest revolution of our times. It can be either best revolution or the worst revolution. All these depend on its management. There is ambiguity among the enablers of management of AI and inter-relationships between enablers and challenges are unknown. It is uncertain that value deliverables are the result of efficient management of AI or other factors are contributing in it. The management of AI is also unstructured as there are no fixed standards for AI management in organizations. The finance sector is not the linear one, as it interacts with many other sectors also. There are abundant complications when trying to create an intelligent system (Gupta, 2017). As finance sector is an important element of our economy, any technology adoption decision taken by this- segment will highly influence it by affecting job roles of our nation. Questions regarding national security and cyber security might be raised. Legal and ethical issues after adoption of automation generate major complexity. Regarding this, the first effect on the business side will also be on the hiring or buying new robots which most probably have an artificial intelligence comparing with its first movers.

Thus a strategic framework is required in order to make successful adoption and management of AI techniques which can deliver valuable output to the finance sector in presence of this complex system.

SECTION 6: SYSTEMS APPROACH TO PROBLEM ANALYSIS

This section provides a brief overview of the systems approach, which will be used to address the current research problem which is management of AI in finance sector.

Introduction to Systems Approach

The system is a regularly interacting or interdependent group of subsystems forming a unified whole. The **systems approach** is an old concept and the term has appeared frequently in management and systems literature recently. The systems approach has been developed as a response with the increasing complexity of the socio-technical and managerial systems.

The systems has various inputs, which go through certain processes to produce outputs, which together, accomplish the overall desired goal for the system. System is usually made up of many smaller systems, or subsystems. For example, an organization is made up of various administrative departments, managerial functions, products, services and individuals. The approach concentrates on the holistic view of the system where the role of each component is studied and analysed to understand the activity of whole system.

System Dynamics Modelling- System dynamics is a conceptual approach that enables to represent the structure and behavior of complex systems over time, providing a method for systems description as well as a useful computational support for simulation (Sterman 2000). It is concerned with using systems ideas to increase understanding of various types of phenomena and to aid in the decision-making which determines action upon the processes involved (Keys, 1990). The main elements of SD are causal loop diagram, stock flow model and dynamic simulation.

Flexible Systems Approach- Flexible systems approach is also termed as soft systems approach or applied systems approach. Soft systems approach is a framework which does not force or lead the systems analyst to a particular ‘solution’, rather to an understanding (Hirschheim et al., 1995).

This approach proposes that a flexible policy framework is needed to strategically meet the dynamics of the new era (Lie et al., 2018) where non-linear and pluralistic complex problems (a problem

situation in which participants do not share same values and beliefs, where debate, disagreement, even conflict, can take place) are prevailing due to the presence of several interacting sub-systems in a system. Some of the main techniques in the soft systems approach for solving complex problems and strategy formulation are Brainstorming, Idea Engineering, Nominal Group Technique (NGT), Interpretive Structural Modelling (ISM), Cross Impact Matrix Multiplication Applied to Classification (MICMAC), Options Field/Profile Methodology, Fuzzy Consideration, Scenario Building Methodology, Delphic Hierarchic Process.

The present study will use flexible systems approach because non-linear and pluralistic complex problems are prevailing due to the presence of several interacting sub-systems in a system.

SECTION 7: OVERVIEW OF PROPOSED STUDY

7.1 Need of the study

Artificial Intelligence is an emerging technology and is catalyst for Industry 4.0. Thus, every industry is adopting AI techniques to reduce human efforts and give accurate and faster results but this disruptive technology also arises questions on human existence. To make this technology, a helping hand and not to become its slave an efficient management of this disruptive technology is necessary.

Hence, artificial intelligence is attractive for financial services segment too, because it eliminates the human errors, excessive work load leading to free up employees for focusing in more meaningful work, and enable organisations to provide personalised financial services to retain customers. The management of AI in this sector is very necessary as it deals with wealth of individuals, corporates and nations.

There is a lot of hype about the adoption of artificial intelligence. It is becoming challenging for organisations to manage the same. Finance sector has some enablers and challenges to the management of AI, yet how they are related to value maximization is unexplained. The possible impacts range from positive and goal oriented to the worst, and might be impossible to be avoided.

Thus, companies need to monitor the incoming changes and adopt the best strategy for companies' sustainability (Omar et al., 2017).

To make the artificial intelligence in finance sector to realize its potential, there has to be clear understanding of the varied problems concerned and effective management of AI should be carried out at personal, corporate, national and international levels because it is the matter of savings and investments of people.

The proposed research would help to identify and understand the various challenging and enabling factors for the better management of AI with consideration of the complexity created by these factors. Also, strategic framework would be developed with the help of hierarchical model under system methodology to resolve the complexity. This research has been proposed by considering the aim of the fourth industrial revolution and 'National strategy for AI', a strategy document proposed by NITI Aayog. Thus the main purpose is to develop a strategic framework for maximizing the value deliverables of the financial services segment through managing AI.

7.2 Objectives of the Study

The proposed research is aimed at accomplishing the following objectives:

Objective 1: To study the present status of adoption and management of artificial intelligence in select financial services.

Objective 2: To identify the enablers and challenges in management of artificial intelligence in financial services.

Objective 3: To develop a hierarchical structural model under relevant contextual relations of the identified enablers and challenges for management of artificial intelligence in select financial services.

Objective 4: To determine the priority of different enablers and challenges for value maximization in financial services.

Objective 5: To examine the inter-relationships in challenges and enablers to management of artificial intelligence in financial services.

Objective 6: To examine the relationship between management of AI and value maximization in financial services sector.

7.3 Research Methodology

7.3.1 Scope of the Study: The proposed study will be focused on management of artificial intelligence techniques in Indian finance- sector.

7.3.2 Data collection

Primary Data: The proposed study is based on the application of the systems approach. The primary data in this case will be collected through series of system science workshops with the panel of 15-20 domain experts.

Experts Profile: Since the proposed research is related to finance sector, various domain experts from this sector would be invited for the multi-stage workshops. The profiles of the domain experts would be academicians of finance field, artificial intelligence and systems approach, managers/employees of established banks, financial services providing companies and insurance companies and AI experts. The brief classification of experts for the proposed study is as follows:

Table 4: Sample Plan for Experts

Workshops	Domain Experts						
	Academicians			Banks	Mutual Funds	Stock Market	Insurance
	Finance	Systems	IT (AI)				
Enablers and Challenges Identification	5	2	2	2	2	2	2
ISM	5	2	2	2	2	2	2
AHP	5	2	2	2	2	2	2
DEMATEL	5	2	2	2	2	2	2

The number of experts may vary and overlap in different workshops of systems sciences.

Secondary Data: Annual reports of various companies of finance sector and other researches highlighting the artificial intelligence adoption and management status in Indian financial services sector.

7.3.3 Research Design: The proposed research is both analytical and descriptive since it uses both systems approach and survey technique, respectively.

7.3.4 Sampling Technique: Judgmental Sampling will be used for both, ethnography study and experts for workshops.

7.3.5 Tools of Data Analysis

Following table reveals the specific methodology which will be used to fulfill the objectives:

S. No.	Objectives of the Study	Proposed Tools
1	To study the present status of adoption and management of artificial intelligence in select financial services.	Secondary data analysis and personal interview with domain experts
2	To identify the enablers and challenges in management of artificial intelligence in financial services.	NGT Workshops and literature survey
3	To develop a hierarchical structural model under relevant contextual relations of the identified enablers and challenges for management of artificial intelligence in select financial services.	Interpretive Structural Modeling (ISM)
4	To determine the priority of different enablers and challenges for value maximization in financial services.	Analytic Hierarchy Process (AHP)
5	To examine the inter-relationships in challenges and enablers to management of artificial intelligence in financial services.	Decision Making Trial and Evaluation Laboratory (DEMATEL)
6	To examine the relationship between management of AI and value maximization in financial services sector.	Survey through Structured Questionnaire

7.3.6 Proposed Tools and Techniques to be used: The proposed research will use the following tools and techniques-

- **Ethnography:** Ethnography is a tool for primary data collection. Ethnography is a study in which researchers directly observe and/or interact with a study's participants in their real-life/natural environment. This research provides an in-depth insight into the user's views. Ethnography methods include direct observation, video recordings, photography and artifact analysis such as devices that a person uses throughout the day. For this, various banks, financial services providing institutions and insurance companies will be visited personally to know the status of AI adoption and performance of sector after adoption resulting in addressing the management of AI.

- **In-Depth Interview:** The managers, technical heads and users of the technology will be interviewed about issues in management of AI.

- **Nominal group technique (NGT):** The nominal group technique is an efficient means for making complex decisions. NGT was developed based on research that indicated that people came up with more and better ideas working silently in a group than when they worked alone. In NGT, a systematic and an organized group meeting held among the participants to facilitate decision making by properly identifying the problems and generating the solutions thereof. Ideally, 10-20 participants give their ideas by writing on slips. There is no interaction among them which provides an equal opportunity to everyone to express their views. The objective of nominal group technique is to resolve the opinion conflicts among the group members and to avoid domination by some individuals as the ideas are generated independently by the participants. Firstly, a facilitator explains the issue to the experts and then each one has to jot down the points. The ideas are then recorded, displayed in front of everyone and discussed. Once all the participants have written their ideas, a clear list of all ideas is prepared. In last participants vote for prioritizing the ideas.

- **Delphi Method:** Delphi method is a systematic method used to gather opinions of panel experts on the problem being encountered, through a series of iterative questionnaires, with a goal of coming to a group consensus. All the anonymous opinions received through first round are presented to the same

experts for review purpose and the experts are required to give justification for the answers given in the first questionnaire and on the basis of it, the revised questionnaire is prepared and is again sent to the same group of experts. The objective of a Delphi technique is to reach to the most accurate answer by decreasing the number of solutions each time the questionnaire is sent to the group of experts, and this process continues until the issues are narrowed, responses are focused, and the consensus is reached. Delphi method will be used when face-to-face interaction is either not possible or not desirable.

- **Interpretive Structural Modeling (ISM):** ISM is a well-established methodology for identifying relationships among specific items, which define a problem or an issue. The ISM process transforms unclear, poorly articulated, complex mental models of systems into visible well defined simpler models. It starts with identification of variables, which are relevant to the problem or issue. Then a contextual relation is chosen and a structural self-interaction matrix (SSIM) is developed based on pair wise comparison of variables. The experts' responses help in preparing the SSIM. Based on the various matrices data, a graphical depiction (digraph) is derived which provides information about hierarchy between the sub-elements in an element. It provides a clearer picture and an understanding of contextual relationships among elements.

- **Analytic Hierarchy Process (AHP):** The Analytic Hierarchy Process (AHP) is also an effective tool for dealing with complex decision making, and may aid the decision maker to set priorities and make the best decision. By reducing complex decisions to a series of pairwise comparisons, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process.

- **Decision Making Trial and Evaluation Laboratory (DEMATEL):** DEMATEL is considered as an effective method for the identification of cause-effect chain components of a complex system. It deals with evaluating interdependent relationships among factors and finding the critical ones through a visual structural model.

- **Fuzzy Consideration:** The classical or basic set theory either wholly includes or wholly excludes any given element. It allows the membership of elements in the set in binary terms, a bivalent condition - an item either belongs or does not belongs to the set. However, in real life situations, certain sets have imprecise boundaries. In fuzzy set theory, elements have degree of membership. It permits gradual assessment of membership of elements in a set describe with the aid of described with the aid of a membership function valued in the real unit interval [0.1]. Fuzzy considerations are incorporated in the techniques of systems analysis as well. In addition to the consideration of interaction between elements and sub elements (binary relationships), it also considers various levels of the possibilities of interaction. This is done for ISM, AHP and DEMATEL, and then it is referred to as Fuzzy ISM, Fuzzy AHP and Fuzzy DEMATEL.

7.3.7 Phases of Proposed Study

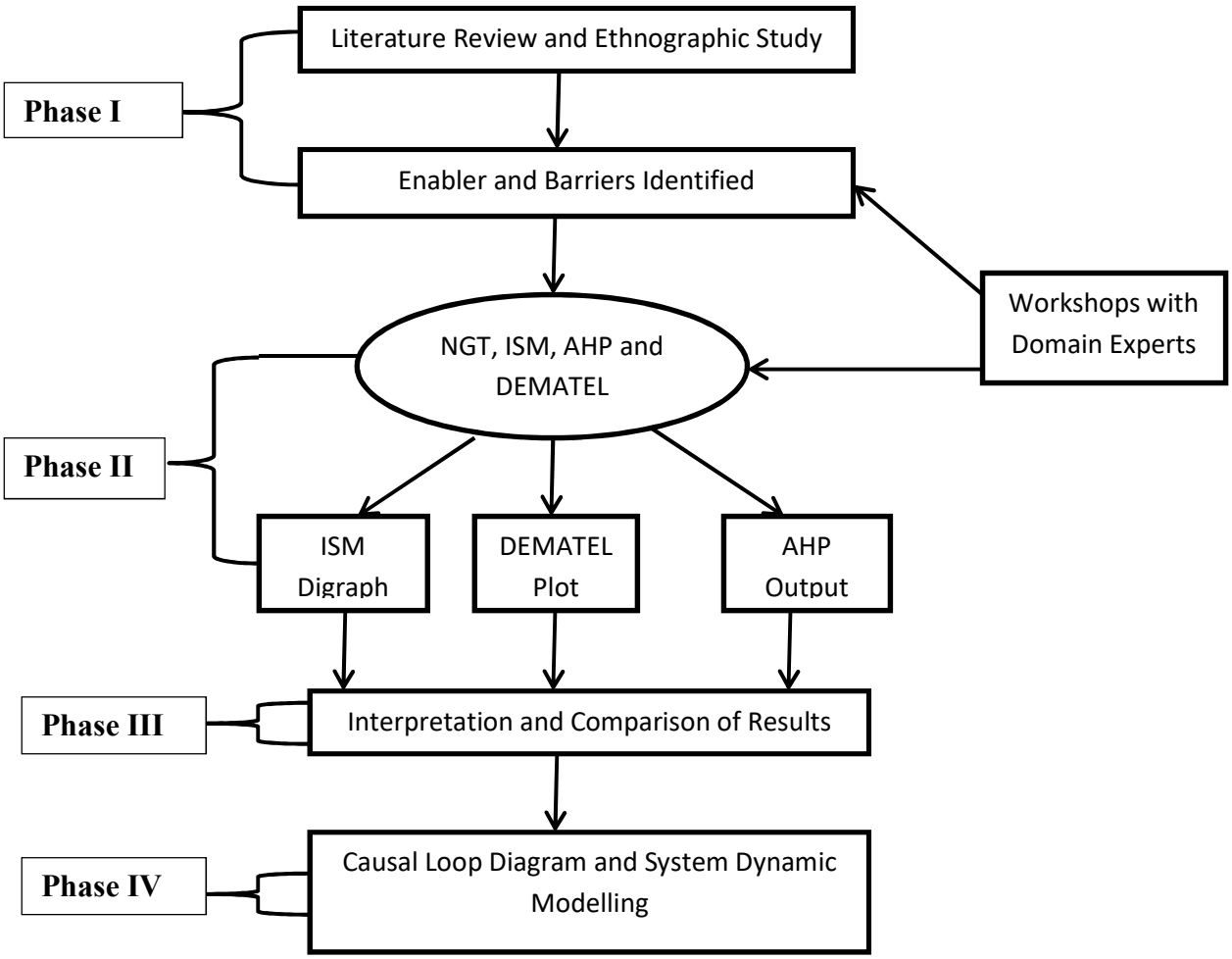

Figure 2: Different Phases of Research Work (Resource: Researcher's own construct

Phase I: Study of the Present Status of AI in Financial Services

It will include the **field survey of companies providing financial services** which have adopted or planning to adopt AI to the present status of AI technology in this sector and **depth interview** of managers, employees and users to know their management strategies for AI and its enablers and challenges what they face in managing AI.

Phase II: Using System Sciences to Find Optimal Solution of the Problem

- In this **NGT workshop** will be conducted to identify the enablers and challenges of AI.
- Various tools like **ISM, AHP and DEMATEL** will be applied in the series of workshops on the factors identified in NGT.
- The technique of fuzzy satisfaction criterion for different strategies may be used to remove the uncertainty and finding optimal strategy.

Phase III: Interpretation and Comparison of Results will be done on the statistically analysed data derived from different workshops.

Phase IV: Developing Dynamic Optimal Strategy

A **causal loop diagram** would be developed on the basis of the discussion or workshop session with domain experts. System Dynamic Modelling will be used for **simulation**.

In addition to the above, the researcher may explore the use of related techniques like system dynamic modeling, Structural Equation Modelling (SEM), Artificial Neural Network (ANN), etc. If appropriate, Regression Analysis can also be adopted.

SECTION 8: PROPOSED CHAPTERIZATION

The proposed research will contain the following chapters:

- Chapter 1: Introduction
- Chapter 2: Review of literature
- Chapter 3: Research design and methodology
- Chapter 4: Data collection and analysis
- Chapter 5: Results and interpretations
- Chapter 6: Conclusion, Managerial implications, and direction for future research

- Bibliography and references
- Appendix

References

1. Accenture (2017). Rewire for Growth: Accelerating India's Economic Growth with Artificial Intelligence. Retreived September 1, 2019 from *Accenture*: https://www.accenture.com/t20171220t030619z__w__/in-en/_acnmedia/pdf-68/accenture-rewire-for-growth-pov-19-12-final.pdf%20-%20zoom=50

2. Accenture (2018). Redefine Banking with Artificial Intelligence. *Accenture*.

3. Adobe (2019. Digital Trends: Financial Services in Focus. *Adobe Systems Incorporated*.

4. Agarwal, A., Gans, J., and Goldfarb, A. (2018). Economic Policy for Artificial Intelligence. *National Bureau of Economic Research*, 139-159, Toranto: University of Chicago Press.

5. Angerhofer, B., and Angelides, M. (2000). System dynamics modelling in supply chain management: research review. *WSC '00 Proceedings of the 32nd conference on Winter simulation*, 342-351, Florida: The Society for Modelling and Simulation International.

6. Attri, R., Dev, N., and Sharma, V. (2013). Interpretive Structural Modelling (ISM) approach: An Overview. *Research Journal of Management Sciences, 2* (2), 3-8.

7. Banwo, A. (2018). Artificial intelligence and financial services: Regulatory tracking and change management. *Journal of Securities Operations and Custody, 10* (4), 354-365.

8. Baruah, A. (2019). AI Applications in the Top 4 Indian Banks. Retrieved August 18,2019 from Emerj: https://emerj.com/ai-sector-overviews/ai-applications-in-the-top-4-indian-banks/

9. Celik, A. E., and Karatepe, Y. (2007). Evaluating and forecasting banking crises through neural network models: An application for Turkish banking sector. *Expert Systems with Applications, 33* (4), 809-815.

10. Chan, M.-C., Wong, C.-C., Tse, W., Cheung , B.-S., and Gordon , Y.-N. (2002). Artificial Intelligence in Portfolio Management. 403-409, Verlag Berlin Heidelberg : Springer.

11. Chatterjee, A., Ayadi, O., and Boone, B. (2000). Artificial Neural Network and the Financial Markets: A Survey. *Managerial Finance, 26* (12), 32-45.

12. Dhanrajani, S. (2019). How artificial intelligence is changing the face of banking in India. *Your Story Media Pvt. Ltd*.

13. Dravis, P. (2018). Artificial Intelligence in Finance The Road Ahead. San Fransusco, CA: *Future Perfect Machine.*

14. Fethi, M. D., and Pasiouras, F. (2010). Assesing bank efficieny and performance with operational research and artificial intelligence techniques: A survey. *European Journal of Operational Research*, 189-198.

15. Financial Stability Board. (2017). Artificial intelligence and machine learning in financial services Market developments and financial stability implications. *Financial Stability Board*.

16. Gauvrit, P. (2017). How AI can deliver a personalized and predictive customer experience. Retrieved August 1A 9, 2019, from Digital CX Conversations by Eptica: https://www.eptica.com/blog/how-ai-can-deliver-personalized-and-predictive-customer-experience

17. Goudarzi, S., Hickok, E., and Sinha, A. (2018). AI in Banking and Finance. *The Centre for Internet and Society*, India.

18. Gupta, N. (2017). A Literature Survey on Artificial Intelligence. *International Journal of Engineering Research and Technology (IJERT)*, *5*, 1-5.

19. He, D., Guo, M., Zhou, J., and Guo, V. (2018). The Impact of Artificial Intelligence (AI) on Financial Job Market. *The Boston Consulting Group. China: China Development Research Foundation.*

20. Ince, H., and Aktan, B. (2009). A comparison of data mining techniques for credit scoring in banking: A managerial perspective. *Journal of Business Economics and management, 10* (3), 233-240.

21. Ivanov, S. H., Webster, C., and Berezina, K. (2017). Adoption of Robots and Service Automation by Tourism and Hospitality Companies. *Revista Turismo and Desenvolvimento, 27/28*, 1501-1517.

22. Jackson, M. (2017). *How artificial intelligence can deliver a personalised banking experience.* Retrieved August 19, 2019, from Finextra: https://www.finextra.com/blogposting/14617/how-artificial-intelligence-can-deliver-a-personalised-banking-experience

23. Kannabiran, G., and Dharmalingam, P. (2012). Enablers and inhibitors of advanced information technologies adoption by SMEs. *Journal of Enterprise Information Management, 25*, 186-209.

24. Keys, P. (1990). System dynamics as a systems-based problem-solving methodology. *Systems Practice, 3* (5), 479-493.

25. Kuo, C.-M., Chen, L.-C., and Tseng, C.-Y. (2017). Investigating an innovative service with hospitality robots. *International Journal of Contemporary Hospitality Management, 19* (5), 1305-1321.

26. Masayuki, M. (2016). The Effects of Artificial Intelligence and Robotics on Business and Employment: Evidence from a survey on Japanese firms. *RIETI Discussion Paper Series 16-E-066*. Japan.

27. Moghaddam, A. H., Moghaddam, M. H., and Esfandyari, M. (2016). Stock Market Index Prediction using Artificial Neural Network. *Journal of Economics, Finance and Administrative Science, 21*, 89-93.

28. Moudud-Ul-Huq, S. (2014). The Role of Artificial Intelligence in the Development of Accounting Systems: A Review. *IUP*.

29. Narain, K., Swami, A., Srivastava, A., and Swami, S. (2019). Evolution and control of artificial superintelligence (ASI): a management perspective. *Journal of Advances in Management Research* .

30. Narrative Science (2015, June 11). 80 Percent of Business and Tech Leaders Say Artificial Intelligence Creates Jobs, Increases Productivity. Retrieved August 21, 2019, from Business Wire: https://www.businesswire.com/news/home/20150611005252/en/80-Percent-Business-Tech-Leaders-Artificial-Intelligence

31. NASSCOM. (2018). Artificial Intelligence for Banking, Finanacial Services and Insurance Sector. *NASSCOM-CMR*.

32. North, R. (2019). How AI Helps Banks and Financial Service in Improving Their ROI. Retrieved August 18, 2019, from Enterprise Edges: https://www.enterpriseedges.com/ai-helps-banks-financial-service-improving-roi

33. O'LEARY, D. E. (1991). Artificial Intelligence and Expert Systems in Accounting Databases: Survey and Extensions. *Expert Systems With Applications, 3*, 143-152.

34. Omar, S. A., Hasbolah, F., and Zainudin, U. M. (2017). The Diffusion of Artificial Intelligence in Governance of Public Listed Companies in Malaysia. *International Journal of Business, Economics and Law, 14(* 2), 1-9.

35. Patel, M. (2018). How AI-powered Mobile Banking App Enhances Customer Experience. *Customer Think*.

36. Perwej, Y., and Perwej, A. (2012). Prediction of the Bombay Stock Exchange (BSE) Market Returns Using Artificial Neural Network and Genetic Algorithm. *Journal of Intelligent Learning Systems and Applications, 4*, 108-119.

37. PwC. (2016). Financial Services Technology 2020 and Beyond:Embracing disruption*, PwC*.

38. Rijmenam, M. v. (2019). How Artificial Intelligence Will Disrupt the Financial Sector. Retrieved August 17, 2019, from Datafloq: https://vanrijmenam.nl/artificial-intelligence-disrupt-financial-sector/

39. Rouse M. (2010). AI in IT tools promises better, faster, stronger ops. Retreived August 17, 2019, from TechTarget: https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence

40. Roy, A., and Kant, A. (2018). National Strategy for Artificial Intelligence #AIFORALL. India: NITI AYOG.

41. Rupali. (2018). AI for Banking, Insurance, and Financial Services. Retrieved August 23, 2019, from DZone: https://dzone.com/articles/artificial-intelligence-for-banking-insurance-and

42. Sapena, O., Botti, V., and Argente, E. (2003). Application of neural networks to stock prediction in "pool" companies. *Applied Artificial Intelligence,17*(7), 661-673.

43. Schierz, P., Schilke, O., and Wirtz, B. (2010). Understanding consumer acceptance of mobile payment services. *Electronic Commerce Research and Applications, 9* (3), 209-216.

44. Schultebraucks, L. (2017). A Short History of Artificial Intelligence. Retreived from https://dev.to/lschultebraucks/a-short-history-of-artificial-intelligence-7hm

45. Sharma, A. (2017). Punjab National Bank To Use AI To Detect Frauds. India: Analytics India Magazine.

46. Shiau, S., Huang, C.-Y., Yang, C.-L., and Juang, J.-N. (2018). A Derivation of Factors Influencing the Innovation Diffusion of the OpenStreetMap in STEM Education. *Sustainability,10*, 1-29.

47. Sinclair, A., Brashear, J., and Shacklad, J. (2018). *AI: The Momentum Mindset.* Accenture.

48. Sushil. (2018). Flexible Systems Methodology: A Mixed-method/Multi-method Research Approach. *Global Journal of Flexible Systems Management, 19*(2), 109-110.

49. Talukder, M. (2012). Factors affecting the adoption of technological innovation byindividual employees: An Australian study. *Procedia - Social and Behavioral Sciences, 40*, 52-57.

50. Towill, D. R. (1993). System dynamics—background, methodology, and applications. Part 1: Background and methodology. *Computing and Control Engineering Journal. 4*(5), 201-208.

51. Uyttendaele , J., and Muylle, S. (2018). Artificial Intelligence in Corporate Banking: A Closer Look at the Potential Impact on E-Business Processes. Belgium: Gent University.

52. Venkatesh, V., and Davis, F. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science, 46*(2), 186-204.

53. Vijai, C. (2019). Artificial Intelligence in Indian Banking Sector: Challenges and Opportunities. *International Journal of Advanced Research (IJAR), 7*(5), 1581-1587.

54. Yeoh, P. (2019). Artificial intelligence: accelerator or panacea for financial crime?. *Journal of Financial Crime, 26*(2), 634-646.

55. Yu, K.-H., Beam , A., and Kohane , I. (2018). Artificial intelligence in healthcare. *Nature Biomedical Engineering*, *2*, 719-731.

56. Zhou, A. (2017). Banks Eager For Artificial Intelligence, But Slow To Adopt. Retrieved August 01, 2019, from Forbes: https://www.forbes.com/sites/adelynzhou/2017/06/30/financial-services-industry-banks-artificial-intelligence-slow-adoption/#1d5c1b6b4f8b

57. ZorBari-Nwitambu, B. (2017). Positive Word of Mouth and Profitability: The Experience of. *International Journal of Managerial Studies and Research (IJMSR),* 5(5), 2-48.

Bibliography

58. Checkland, P. B. (1999). Systems Thinking, Systems Practice. Chichester, UK: John Wiley and Sons Ltd. ISBN 0-471-98606-2

59. Wilson, B. (2001), Soft Systems Methodology Conceptual Model Building and its Contribution, Chichester,UK: John Wiley and Sons Ltd. ISBN 0-471-89489-3

60. Saaty, T.L., 1980. The Analytic Hierarchy Process, McGraw-Hill, New York.